

International **IR** Rectifier

HEXFRED™

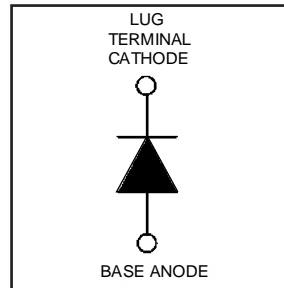
PD -2.451 rev. B 03/99

HFA180NH40R

Ultrafast, Soft Recovery Diode

Features

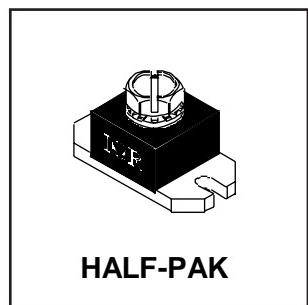
- Reduced RFI and EMI
- Reduced Snubbing
- Extensive Characterization of Recovery Parameters



$V_R = 400V$
$V_F(\text{typ.})^{\circledcirc} = 1.1V$
$I_F(\text{AV}) = 180A$
$Q_{rr} (\text{typ.}) = 420nC$
$I_{RRM}(\text{typ.}) = 8.7A$
$t_{rr}(\text{typ.}) = 45ns$
$di_{(\text{rec})M}/dt (\text{typ.})^{\circledcirc} = 280A/\mu s$

Description

HEXFRED™ diodes are optimized to reduce losses and EMI/RFI in high frequency power conditioning systems. An extensive characterization of the recovery behavior for different values of current, temperature and di/dt simplifies the calculations of losses in the operating conditions. The softness of the recovery eliminates the need for a snubber in most applications. These devices are ideally suited for power converters, motors drives and other applications where switching losses are significant portion of the total losses.



Absolute Maximum Ratings (per Leg)

	Parameter	Max.	Units
V_R	Cathode-to-Anode Voltage	400	V
$I_F @ T_C = 25^\circ C$	Continuous Forward Current	280	A
$I_F @ T_C = 100^\circ C$	Continuous Forward Current	138	
I_{FSM}	Single Pulse Forward Current ①	1200	mJ
E_{AS}	Non-Repetitive Avalanche Energy ②	1.4	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	521	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	208	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C

Thermal - Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
R_{thJC}	Junction-to-Case	—	—	0.20	°C/W
R_{thCS}	Case-to-Sink, Flat, Greased Surface	—	0.15	—	K/W
Wt	Weight	—	26 (0.9)	—	g (oz)
	Mounting Torque ④	15 (1.7)	—	25 (2.8)	lbf·in (N·m)
	Terminal Torque	30 (3.4)	—	40 (4.6)	
	Vertical Pull	—	—	80	
	2 inch Lever Pull	—	—	40	lbf·in

Note: ① Limited by junction temperature
② $L = 100\mu H$, duty cycle limited by max T_J
③ $125^\circ C$

④ Mounting surface must be smooth, flat, free of burrs or other protrusions. Apply a thin even film of thermal grease to mounting surface. Gradually tighten each mounting bolt in 5-10 lbf·in steps until desired or maximum torque limits are reached. Module

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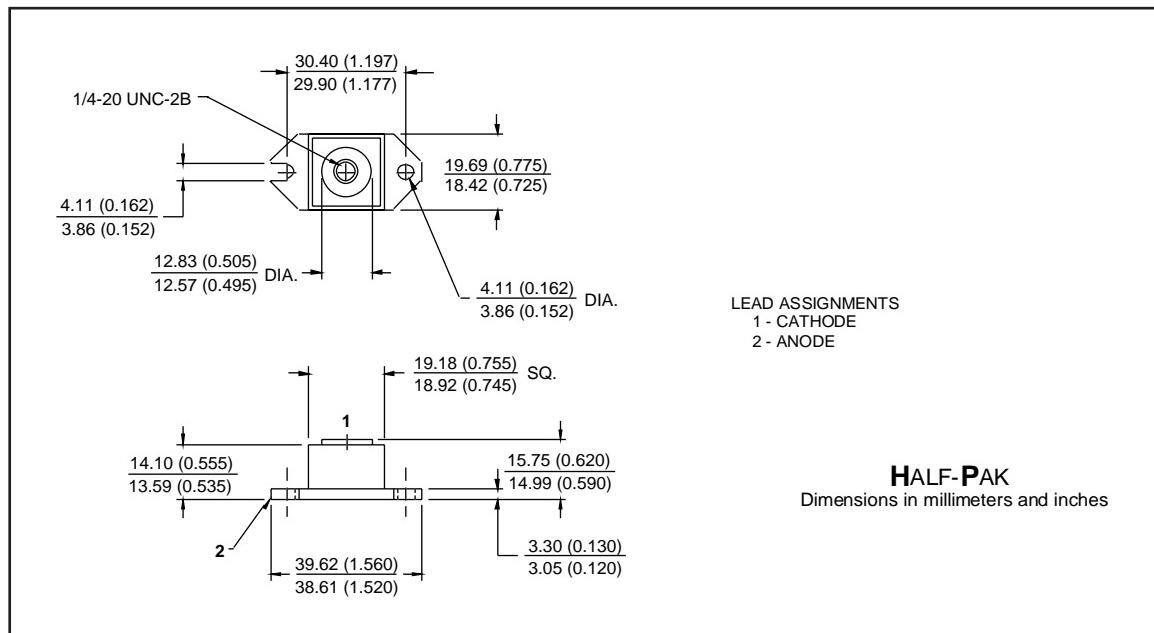
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Electrical Characteristics (per Leg) @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
V_{BR}	Cathode Anode Breakdown Voltage	400	—	—	V	$I_R = 100\mu\text{A}$
V_{FM} See Fig. 1	Max Forward Voltage	—	1.10	1.35	V	$I_F = 180\text{A}$
		—	1.40	1.65		$I_F = 360\text{A}$
		—	1.10	1.30		$I_F = 180\text{A}, T_J = 125^\circ\text{C}$
I_{RM} See Fig. 2	Max Reverse Leakage Current	—	2.0	12	μA	$V_R = V_R$ Rated
		—	3.0	16	mA	$T_J = 125^\circ\text{C}, V_R = 320\text{V}$
C_T	Junction Capacitance See Fig. 3	—	370	500	pF	$V_R = 200\text{V}$
L_S	Series Inductance	—	5.0	—	nH	From top of terminal hole to mounting plane

Dynamic Recovery Characteristics (per Leg) @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
t_{rr} See Fig. 5	Reverse Recovery Time	—	45	—	ns	$I_F = 1.0\text{A}, dI_f/dt = 200\text{A}/\mu\text{s}, V_R = 30\text{V}$
		—	90	140		$T_J = 25^\circ\text{C}$
		—	290	440		$T_J = 125^\circ\text{C}$
I_{RRM1} I_{RRM2} See Fig. 6	Peak Recovery Current	—	8.7	20	A	$I_F = 180\text{A}$
		—	18	30		$V_R = 200\text{V}$
Q_{rr1} Q_{rr2} See Fig. 7	Reverse Recovery Charge	—	420	1100	nC	$T_J = 25^\circ\text{C}$
		—	2600	7000		$T_J = 125^\circ\text{C}$
$dI_{(rec)M}/dt_1$ $dI_{(rec)M}/dt_2$ During t_b See Fig. 8	Peak Rate of Fall of Recovery Current	—	300	—	$\text{A}/\mu\text{s}$	$T_J = 25^\circ\text{C}$
		—	280	—		$T_J = 125^\circ\text{C}$



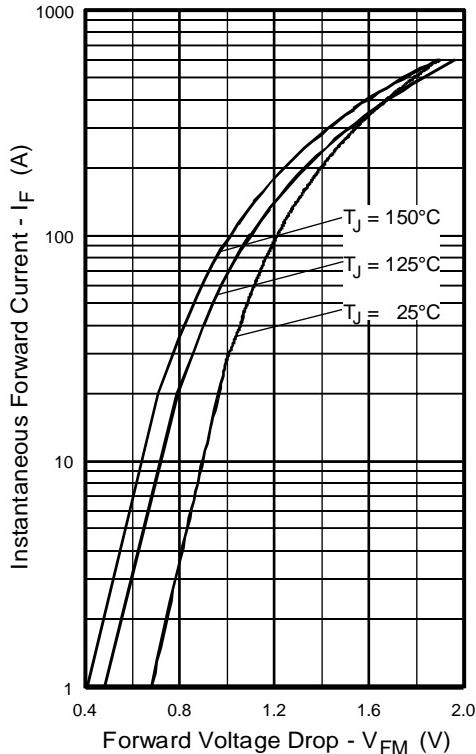


Fig. 1 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

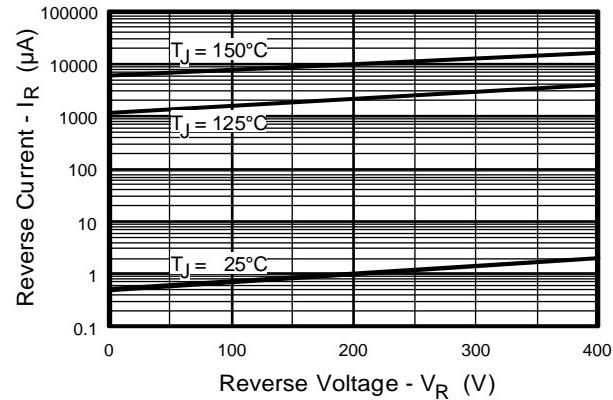


Fig. 2 - Typical Reverse Current vs. Reverse Voltage

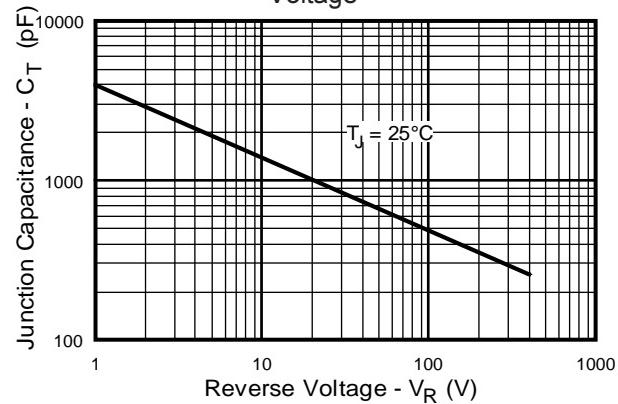


Fig. 3 - Typical Junction Capacitance vs. Reverse Voltage

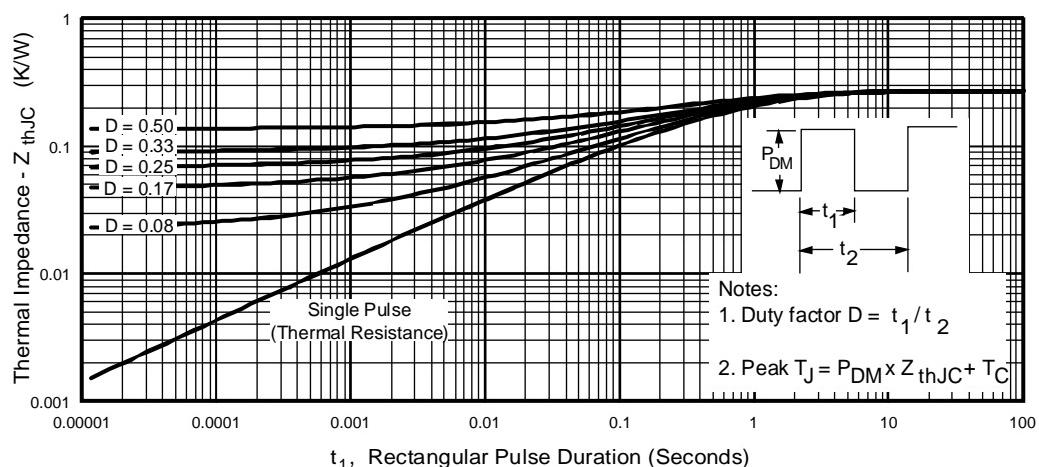


Fig. 4 - Maximum Thermal Impedance Z_{thJC} Characteristics

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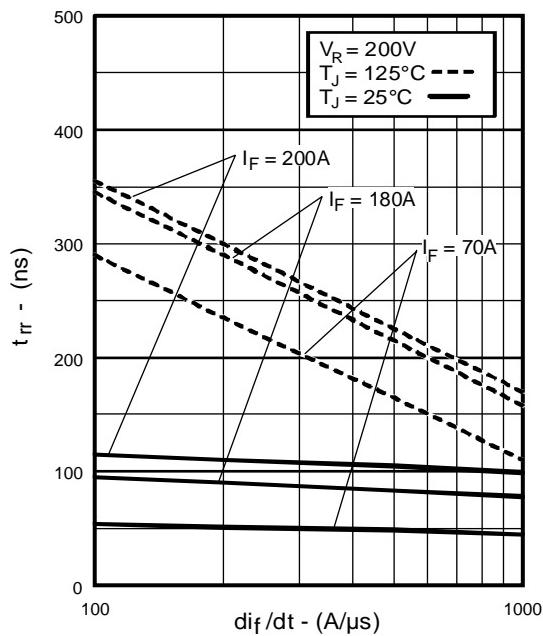


Fig. 5 - Typical Reverse Recovery vs. di_f/dt

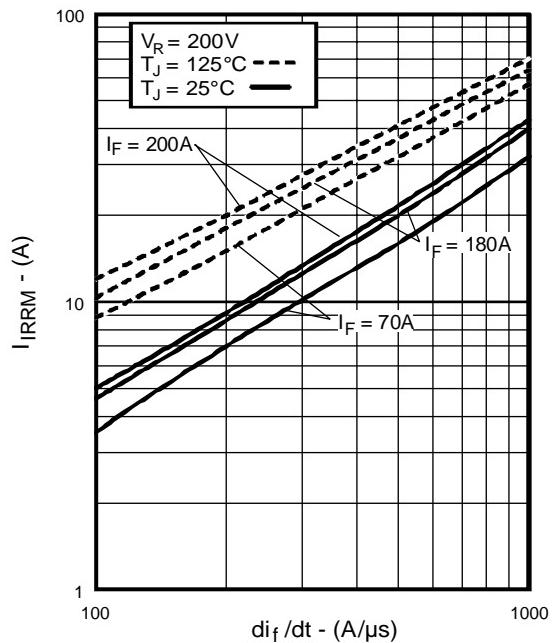


Fig. 6 - Typical Recovery Current vs. di_f/dt

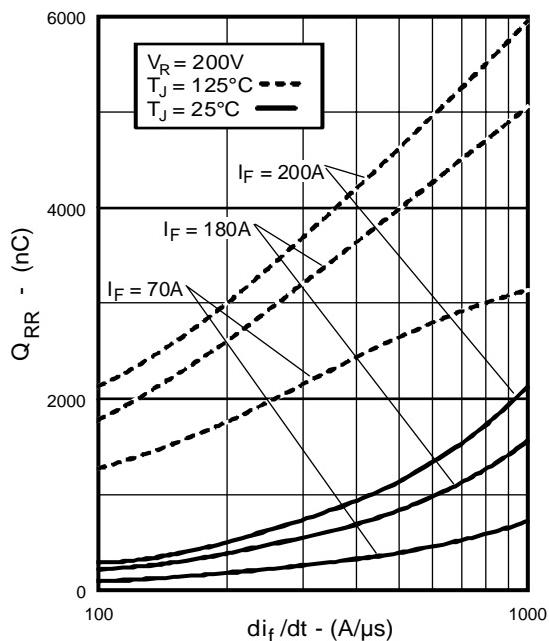


Fig. 7 - Typical Stored Charge vs. di_f/dt

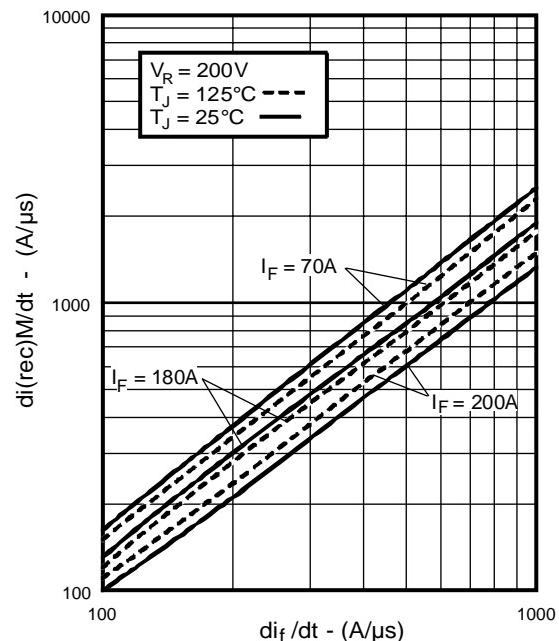
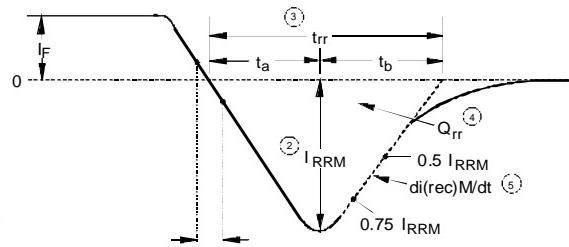
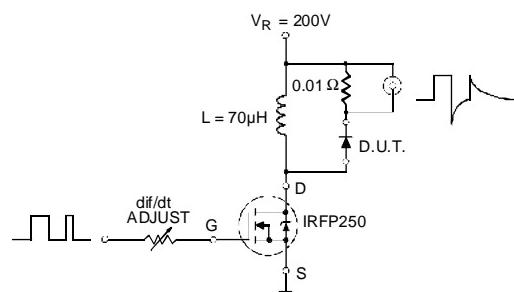


Fig. 8 - Typical $dI_{(rec)}/dt$ vs. di_f/dt

REVERSE RECOVERY CIRCUIT



1. $\frac{di}{dt}$ - Rate of change of current through zero crossing

2. I_{RRM} - Peak reverse recovery current

3. t_{rr} - Reverse recovery time measured from zero crossing point of negative going I_F to point where a line passing through 0.75 I_{RRM} and 0.50 I_{RRM} extrapolated to zero current

4. Q_{rr} - Area under curve defined by t_{rr} and I_{RRM}

$$Q_{rr} = \frac{t_{rr} \times I_{RRM}}{2}$$

5. $\frac{di_{(rec)}I}{dt}$ - Peak rate of change of current during t_b portion of t_{rr}

Fig. 9 - Reverse Recovery Parameter Test Circuit

Fig. 10 - Reverse Recovery Waveform and Definitions

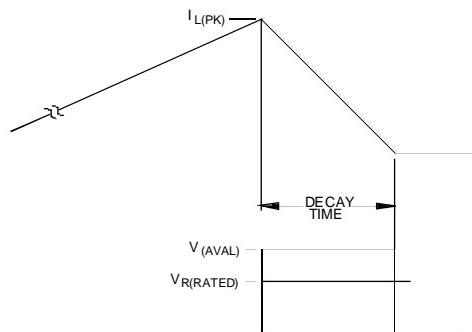
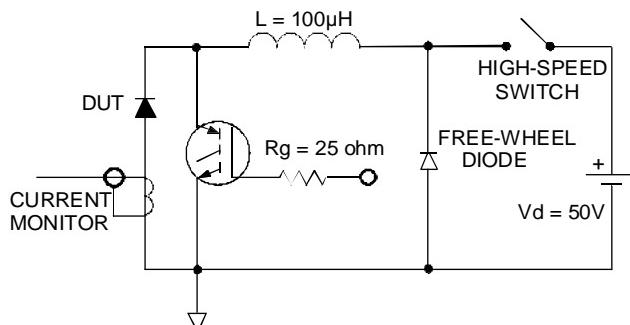


Fig. 11 - Avalanche Test Circuit and Waveforms

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